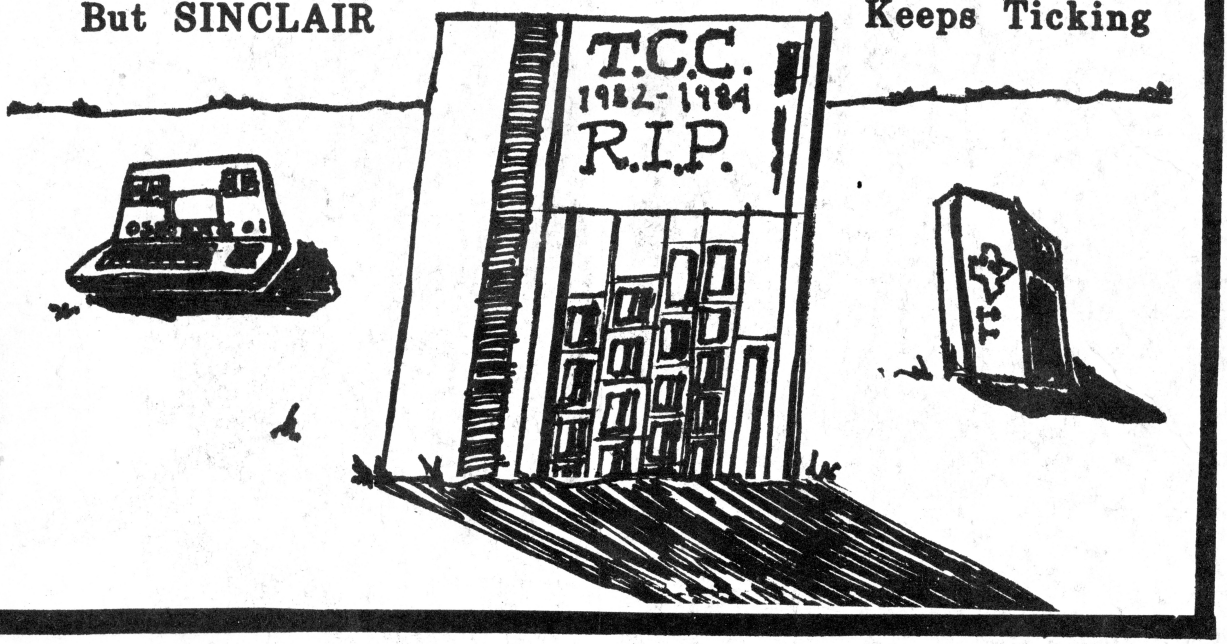
T·S Horizons

Affordable Quality for the Timex Computer User

MARCH NO. 4 $1.25

TIMEX Takes A Licking

But SINCLAIR Keeps Ticking



BANK SWITCHING FOR THE TS 1000 Part 1

Expand To 96K – by Paul Hunter

PROGRAMMING

ERROR RECOVERY

NUMERICAL ANALYSIS

SIMPSON'S RULE

REVIEWS

Games for the TS 2068

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► *READ THE REVIEWS:*

What a super product!...conceived and executed very nicely...and with quality components.
(SYNTAX QUARTERLY Winter 82)

8K Nonvolatile memory is a gem! It has so many possible uses...I recommend this board most heartily.
(OKLAHOMA S.U.G. Newsletter 1/3)

We found the documentation to be far superior to that (of) most hardware we've received.
(S.U.N. Newsletter Nov/Dec 82)

For versatility this is even better than an EPROM...ranks quite high on the list of "must-haves"...
(SYNC Magazine Mar/Apr 83)

Provides the user with instant software...an extremely versatile memory extension...
(Z-WEST June 83)

INTRODUCTION

This memory board is designed to fill the transparent 8K block of memory (from 8K to 16K) in a ZX81-16K system. This area of memory is an ideal place to store, either permanently or temporarily, machine language routines or data which are to be used by the BASIC system.

Sample utilities are included with the kit.

The use of HM6116LP 2K CMOS RAM memory IC's with their own reserve power supply means that routines stored in the RAM are nonvolatile — the RAM retains its memory even when the ZX81 is switched off or reset. Moreover, being RAM, the routines you store in the memory are easily modified. The lithium cell supplied with the board will maintain sufficient reserve power for almost ten years.

ASSEMBLY

Complete step-by-step instructions in a 20 page manual make assembly of the board easy. The kit (pictured above) is complete with a silkscreened solder-masked printed circuit board, all capacitors, resistors, transistors, sockets, connectors, integrated circuits, and the lithium cell. The board is supplied with one 2K CMOS 6116LP-3 RAM — it will accomodate three more for a total of 8K.

Complete kit with one 2K 6116LP-3	**$32.95**
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HUNTER, 1630 FOREST HILLS DRIVE, OKEMOS, MI 48864

T-S Horizons

Affordable Quality for the Timex Computer User
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ENTER

Dear Readers;

As you may know by now, Timex is no longer in the computer business. Apparently, they were afraid of taking a "licking" in the home computer market this year (for more details see NEW s analysis). I suppose many of you are wondering what this will mean for the future of T-S Horizons.

Actually, we are fairly confident of the future of TS Horizons and Sinclair computing in general. Sinclair Research which, of course, markets the Sinclair computers that the Timex computers are derived from, is going strong and actively developing new prodducts. We expect them to take up the reins dropped by Timex and actively market their computer products in the U.S.

Our circulation has grown slowly but steadily as more and more people are becoming aware of TS Horisons, and as we grow, we are able to provide you with more useful information.

So if you're happy with your computer, whether of the ZX or TS variety, there is no reason you should let the demise of the Timex Computer Corporation affect your enjoyment of Timex (or Sinclair, whichever) computing or of TS Horizons.

Sincerely,

Rick Duncan

Rick Duncan

NEWT ANALYSIS

As the Wall Street Journal put it in a February 23 headline, "Timex, Anticipating Market Upheavals, Discontinues Sale of Home Computers". While market trends may have been an important factor in Timex's decision, the report missed some other considerations that may have been more immediate reasons for Timex's withdrawal. The Journal report calls Timex "a victim of the price war it helped launch."

Some of us forget that Timex is (was) not just a computer company. The watch and clock business is the mainstay of Timex and the company has had great difficulty in recent years in that area due to fierce foreign competition.

Timex began making inexpensive and durable watches in the 1950's. The company soon became the world's largest watch maker and by the late 1960's, Timex had more than 50% of the U.S. watch market, and 20 of the world market, with the remainder being supplied by smaller American companies and Swiss and other European companies. This made Timex a target for foreign competition.

In the late 1970's, the Japanese became a powerful, eventually, dominant force in the watch business and introduced a flood of cheaper watches in the U.S. and around the world. With cheaper labor and electronic technology, Japanese watch makers easily undercut Timex and its bulky, mechanical watch technology.

Recently though, Hong Kong watch makers have entered the market with even lower labor costs than Japan and have forced many Japanese companies out of business. The situation has led to a major glut of watches of all price ranges. In 1983, Hong Kong alone produced nearly 300 million watches, which estimated to equal the entire annual world demand.

Timex has had to make major adjustments to survive corporately. All of its watch-making has been moved to Asian plants. Thousands of American workers have been terminated. Timex recently sold its gyroscope business to Bendix Corporation for $15 million. In January, 1984, it sold its headquarters building in Middlebury, CT, then leased back a portion of it. Some industry analysts have predicted that the company has little chance for survival.

Timex began assembling Sinclair computers in 1980. In an effort to diversify, they made an agreement with Sinclair to market the Timex-Sinclair line of computer in North America. Timex had also been developing a line of health care products (Health Chex) - digital blood pressure and pulse gauges, thermometers, and bathroom scales. In this area, it is said they have been somewhat successful.

Timex introduced the TS 1000 in September 1982 and sold more than a half million at about $99.95 each in the fourth quarter. In 1983, they sold 1.2 million computers for the whole year (which includes the TS 1500 and TS 2068, but mostly the TS 1000) but the price for the TS 1000 had dropped as low as $29.95, due to strong competition from Texas Instruments, Commodore, and Radio Shack who lowered prices on their home computers.

To aggravate the situation, Timex was notoriously slow at introducing new

products. Even the TS 2068, which has recently been receiving excellent reviews, was not widely available to computer shoppers by Christmas 1983, although it was supposed to be on sale by mid 1983. Timex had difficulty in recruiting mass merchandisers to market the new computer.

In 1983, Timex lost 100 million dollars, with revenues of $400 million. A Business Week article (February 20, from which many of the above figures were taken) states that "The company's strategy is to rebuild its watch market and make itself less-vulnerable by broadening its base with home health care products and home computers". However, it appears that Mike Jacobi, the new Vice-President of Marketing at Timex, was mostly concerned about the watchmaking business. Refering to the company's watches, Businessweek quotes him, "We were thick, fat, ugly, over priced, and behind in technology." Upon taking charge at Timex, he immediately combined the three sales divisions - timepieces, computers, and health products into one - and Dan Ross, former Vice-President of Operations for Timex Computer Corporation resigned.

On February 21, Jacobi announced Timex was out of the computer business. His analysis was that the home computer "industry is on a kamakaze path," to market upheavals and price wars, and his prognosis of the market for 1984 is poor. (He seems to follow Wall Street's "concensus" that IBM will be the only computer company by 1990). He also stressed that the "prized relationship" between Timex and its retailers had to be protected from instability .

Timex did decide not to abandon its fledgeling home health care products, however, presumably because there is less competition in that field, and due to its established network of drug and discount store outlets, which would provide an excellent market for such products.

Sinclair's decision not to market its new 32-bit business-oriented computer, the QL, through Timex, was taken as a reflection on Timex's poor performance with other Sinclair related products. Perhaps, Sinclair had gotten wind of Timex's decision to drop computers, even before the announcement.

Jacobi has promised that Timex will honor all service under warranty and provide after-warranty service. The Timex hot line (1-800-24-TIMEX) will be maintained as long as they receive sufficient calls to justify keeping it up. Jacobi has said that Timex will reduce its prices (possibly to under $100 for the TS 2068) they won't just dump the inventory at "fire-sale" prices.

Although comparisons of Timex with Texas Instruments are inevitable, I don't believe Timex users should despair that there will be a drying up of software and peripherals for the TS 1000 or the 2068.

Don't forget that Sinclair was around in England long before (relatively) anyone heard of the TS 1000. Sinclair is still actively marketing the ZX-81 and Spectrum computers around the world. With the withdrawal of Timex, there is nothing to stop Sinclair from marketing computers in the U.S. There is also a vast third-party industry of software and peripherals makers for Timex and Sinclair computers. Perhaps the worst effect is that the future of the TS 2068 is uncertain. While the 2068 is a definite imporvement over the

Sinclair Spectrum, Sinclair may not be able to or may not have the desire to obtain the rights to the 2068 from Timex.

The TI 99-4A was a computer with a lot of inherent limitations, very little third-party support, not much software, and a very low performance-to-price-ratio. Yet there are still rumors that companies are negotiating for the rights to the 99-4A, and Atari and others are making software for the computer. With all the advantages of the TS 2068, a new company may seek rights to Timex/Sinclair Technology.

The final analysis, what have we lost-if Sinclair or another company actively market ZX-81 and Spectrum-type computers and peripherals in the U.S.

1) The Timex hot line.
2) Timex Ramblings newsletter (no great loss from what I've seen).
3) The apparently ineffective marketing and long development times of the people at Timex.
4) And perhaps most sustantially, Timex and Sinclair users in America, as a whole, stand to lose some amount of respect from other computer users.

Ive already had friends who have said to me, "See, I told you Timex would never make it," and "You ought to change the name of your magazine to TRS-80-HORIZONS." Some people can only respect big names like IBM, Apple, and Radio Shack.

As far as I'm concerned, that's not much of a loss.

READER INPUT

DISK DRIVES AND TRACY NORRIS

Dear Rick,

Thank you for your letter and the issue #2 of T-S Horizons. You were correct in assuming my reservations (about T-S Horizons) had to do with Tracy Norris and it came as no surprise that his much heralded disk drive did not materalize.

Tracy reviewed my board and kit in his Users' Group magazine and gave it a really excellent rating so I've no complaints on that score. He used to call me collect and ask me questions, which made me wonder. His first article in T-S Horizons disappointed me quite a lot since it was a direct copy of an earlier one published in SYNC magazine by George Ingle (Sept/Oct '82) -- even the component values are identical. I enclose a copy. There is obviously nothing wrong with including a repeat-key modification in T-S Horizons since it is a useful feature but I should like to see some acknowledgement of the original.

Sincerely, Paul Hunter, Okemos, MI

Thank you for bringing this matter to our attention, Paul. Of course T-S Horizons neer intended to copy Mr. Ingle's work, and we had no knowledge of the previous article. A personal apology is being sent to him.

Mr. Norris has not responded to several letters sent to him by us, and has refused to talk with us when we have reached him by phone. T-S Horizons is no longer associated with Tracy Norris, and we do not endorse Mr. Norris, Norris Radio and Electronics, or T-Tech Industries. We deeply regret having publicized a product which we now feel will never become available. Mr. Norris no longer lives at the address published in TSH#1, but he is currently living and working in Slidell, LA.

"GREATLY IMPRESSED"

Dear T-S Horizons:

I am greatly impressed with your small magazine. As my subscrition to Computers and Electronics ran out, I was snowbound by subscription offers. Your magazine wasn't a major name or as big as most of the rest but from your first two issues, I realize that it was the one that hit closest to home. Keep up the good work.

Sincerely yours, John Mayer, Whitehouse TX

Dear Rick:

Just a quick note here to say good luck on your T-S Horizons effort. Your premier issue looks good enough for me to say "here's my subscription." I particularly enjoyed K. D. Lewis' simultaneous solutions article.

I would encourage you to provide information for the advanced users as well as the beginners. Too many Timex related publications are cluttered with games and nothing else. I have many Memotech peripherals for my computer and I enjoyed your review of the GP100A printer and interface which I am considering purchasing, so that I can dash off letters like this!

About two months ago I founded a user group in the Salt Lake City area and will circulate your publication among our group.

Larry Scanlan, 2718 E. 9725 South, Sandy UT 84092

UNIFORM QUALITY?

Good day,

As an owner of a 16K Timex/Sinclair 1000, I would like to extend my gratitude to you for publishing T-S Horizons. It is undoubtedly the best publication for TS1000 owners I have seen yet.

Friendly suggestion: The format of your magazine is commendable but the finished product is slightly less than polished. The cover and center page of No. 3 were fine; however, the rest of your book tends to disintegrate and become unreadable due to the poorer quality paper used. It would be much more asthetically pleasing if it were of a uniform quality.

Thank you for your time and keep up the good work.

Sincerely, Robert Farley, Jackson, OH

The quality of paper in each issue of T-S Horizons is determined by the amount of advertising and subscription income. And we haven't been overwhelmed by either. However we are always trying to improve the quality and format of the magazine, and in the near future we think you'll see some changes.

"WHAT'S GOING ON?"

Gentlemen:

Just received same newsletter this month as you sent last month. What's going on! First the disk drive then this! You'd better get your act together!

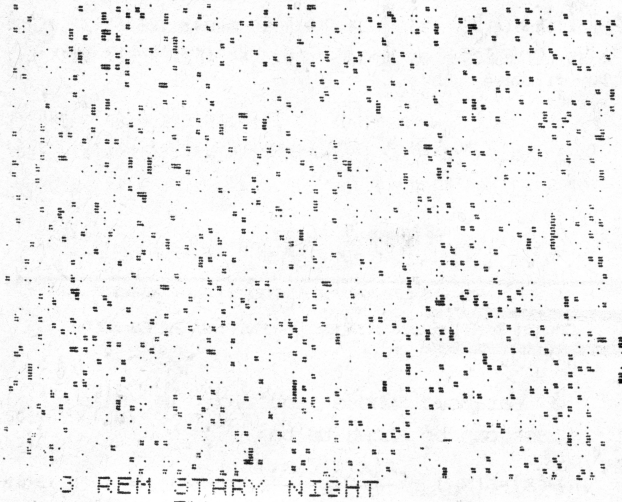
Peter Callinicos, President, Timex Sinclair Users Group, Mile High Chapter, 12026 W. Virginia Place, Lakewood, CO 80228

Peter, I can understand your confusion, with issue #3 being late and getting two copies of issue #2. We have been mailing sample copies to names on mailing lists we have obtained from various sources and there may have been some overlap with our subscription list.

We really appreciate all the readers who have taken the time to write us. It is an immense help to know what you like and dislike about T-S Horizons and what you want ot see in future issues. We try to respond personally to any letters that ask for a response. Please send a stamped, self addressed envelope.

GOSUBs

For the TS 2068



```
  3 REM STARY NIGHT
        BY
        JOHN RICHARD COFFEY
        BOX 448
        SCOTTSBURG, IN 47170

  4 PAPER 0: BRIGHT 1: BORDER 0
: CLS
  7 FOR p=0 TO 1
 10 FOR l=1 TO 704
 20 LET a=INT (RND*128)*2
 30 LET b=INT (RND*88)*2
 50 INK 7*RND: PLOT a,b: IF p T
HEN PLOT a+1,b: PLOT a,b+1: PLOT
 a+1,b+1
 60 NEXT l
100 NEXT p
```

ZX81/TS1000/1500

```
 10 POKE 16418,15
 20 INPUT A$


  5 POKE 16390,119
 20 INPUT A$

  5 POKE 16390,119
 10 POKE 16418,15
 20 INPUT A$
 30 REM SUBMITTED BY J. MARION
```

ZX81/TS1000/1500 + TIMEX PRINTER

```
  10 REM Y*PEEK CLS TAN
 100 POKE 16515,140
 110 LET A=USR 16514
 120 POKE 16515,0
 130 LET A=USR 16514
 140 GOTO 100
 200 REM *BE READY TO       *
         *TURN OFF PRINTER  *
 210 REM SUBMITTED BY J. MARION
```

HARDWARE Hints

These schematics for the edge connectors on the TS 2068 were submitted by Paul Hunter. They are not included in the 2068 manual. Figure 1 is for the main edge connector (rear of machine) and Figure 2 is for the Command Cartridge port.

THE MAIN EDGE CONNECTOR

	B	A	
EAR	1	1	TAPE OUT
DAISY IN	2	2	DAISY OUT
+15	3	3	A7R Buffered Refresh address bit 7

PINS 4 through 26 same as ZX81/TS1000 except that $\overline{\text{RAMCS}}$ pin 5A and $\overline{\text{ROMCS}}$ pin 26B are NC (not connected). In addition, +9V is no longer available at pin 5B.

RGB red	27	27	$\overline{\text{EXROM}}$	Enable for extension ROM
RGB green	28	28	$\overline{\text{ROSCS}}$	Enable for external ROM oriented software
RGB blue	29	29	$\overline{\text{BE}}$	
GND	30	30	GND	
video composite	31	31	sound	
GND	32	32	GND	

BOTTOM TOP (component side)

Figure 1

THE TCC DOCK CONNECTOR

Buffered	A14	1	2	+5V		
	A12	3	4	A13	Buffered	
	D0	5	6	D7		
	D1	7	8	A0		
	D2	9	10	A1		
	D6	11	12	A2		
	D5	13	14	A3		
	D3	15	16	A15	Buffered	
	D4	17	18	$\overline{\text{MREQ}}$	Buffered	
Buffered	$\overline{\text{IORQ}}$	19	20	A7R	Buffered	Refresh
Buffered	$\overline{\text{RD}}$	21	22	$\overline{\text{MI}}$		address Bit 7
Buffered	$\overline{\text{WR}}$	23	24	A8		
	A7	25	26	A9		
	A6	27	28	A10		
	A5	29	30	A11		
	A4	31	32	$\overline{\text{RFSH}}$	Buffered	
Bank enable	$\overline{\text{BE}}$	33	34	$\overline{\text{EXROM}}$	Enable for	
External ROM firmware select	$\overline{\text{ROSCS}}$	35	36	GND		extension ROM

BOTTOM TOP (component side)

Figure 2

NUMERICAL ANALYSIS

SIMPSON'S RULE
by Ken Lewis

Frequently, it is desirable to determine the integral of a continuous function f(x) over some interval $a \leq x \leq b$. A simple and accurate method of doing this is to use Simpson's Rule, named after the Englishman Thomas Simpson (1710-1761). The procedure assumes a partitioning which divides interval [a,b] into n subintervals of equal length h=(b-a)/n, where n must be an even number. Effectively, three consecutive points, for example (X_o, $f(X_o)$), (X_1, $f(X_1)$), (X_2, $f(X_2)$) are fit to a parabola whose equation in this case can be shown to be:

$$p(x)=f(x_o) + \frac{f(x_1)-f(x_o)}{h}(x-x_o) + \frac{f(x_o)-2f(x_1)+f(x_2)}{2h^2}(x-x_o)(x-x_1).$$

Since p(x) is only a second degree polynomial, we can find $\int_{x_o}^{x_2} P(x)dx$.

This will evaluate to $\int_{x_o}^{x_2} P(x)dx = \frac{h}{3}$ $[f(x_o)+4f(x_1)+f(x_2)]$. This later expression approximates the area under the graph of f on the interval $[x_o,x_2]$. The

same is done for the subintervals $[x_2, x_4]$, $[x_4, x_6]$.....$[x_{n-2}, x_n]$. Each of these indices must be even, which makes it necessary for n to be even. The sum of the areas under the parabolas thus obtained serves as an approximation to

$$\int_a^b f(x)dx = \frac{b-a}{3n}[f(x_0)+4f(x_1)+2f(x_2)$$

$$+4f(x_3)+2f(x_{n-2})+4f(x_{n-1})+f(x_n)].$$

This is the famous Simpson's Rule.

THE PROGRAM

The program must be changed (statement 310, right hand side) to incorporate the function you want to integrate. This should be altered so that the right hand side of the equation is the integrand of your problem. Once this is done, then put, the program in the "RUN" mode. Only two additional pieces of information are required at this point, i.e., the limits of integration. Input first the lower limit, then the upper limit of integration. The program will lease iterating when two successive computations of the integral do not differ by more than .00001 (This can be changed to whatever tolerance you desire (line 230)).

EXAMPLE:

Suppose we desire to determine the integral $\int_{3.5}^{5.6} x dx$. The first step is to make sure that the integrand (x) is placed on the right hand side of the equation in statement 310 of the program. Then the "RUN" mode is entered. A prompt for the lower limit of the integral is given "INPUT LOWER LIMIT", and the value 3.5 is entered. Similarly, the upper limit is prompted, and the value 5.6 is input. The answer is printed out, as shown, and is 44.247.

```
 10 REM SIMPSON
 20 INPUT A
 30 INPUT B
 40 LET SUMP=0
 50 LET N=8
 60 LET DELTAX=(B-A)/N
 70 LET SUME=0
 80 LET SUMO=0
 90 FOR K=2 TO N STEP 2
100 LET X=A+DELTAX*(K-1)
110 GOSUB 300
120 LET SUMO=SUMO+4*F*DELTAX/3
130 NEXT K
140 FOR K=3 TO N STEP 2
150 LET X=A+DELTAX*(K-1)
160 GOSUB 300
170 LET SUME=SUME+2*F*DELTAX/3
180 NEXT K
190 LET X=A
200 GOSUB 300
205 LET F0=F*DELTAX/3
210 LET X=B
215 GOSUB 300
220 LET FN=F*DELTAX/3
225 LET SUMN=F0+SUME+SUMO+FN
230 IF (SUMN-SUMP)<=.0001 THEN
GOTO 350
235 LET SUMP=SUMN
238 LET N=2*N
240 GOTO 60
250 REM **********************
260 REM ****CHANGE FUNCTION****
270 REM ****WITH EACH NEW******
280 REM ****PROBLEM**********
290 REM **IN LINE 310********
300 REM SUBROUTINE
310 LET F=X
320 RETURN
350 PRINT "THE INTEGRAL BETWEEN
"
360 PRINT "THE LIMITS",A,"AND",
B
370 PRINT "EVALUATES TO BE",SUM
N
380 STOP
```

BANK SWITCHING FOR THE TS 1000–Part 1

by Paul Hunter

A common complaint heard about small computers like the ZX81 or VIC20 is that their memory is too limited and that the computers are therefore unsuitable for serious applications. As a result, some of the most popular peripherals have been 16K, 32K, and 64K RAM packs. The problem is particularly acute with the ZX81/TS1000 because the active BASIC program area is limited to the region between 16K and 48K. Even then care must be taken to avoid having the display file bridge the 32K boundary.

There are two cases in which more memory is desirable. The first is encountered when large amounts of data need to be manipulated. It does not take a very long address list, test file, or stock inventory to fill up all the available memory in a Z80-64K system. The common solution is to provide a secondary memory capability such as a disc drive or at worst a cassette tape recorder. Fast load utilities like SDS or ZXLR8 aid in manipulating data files to and from cassette tape. The AERCO DOS (disc operation system) does the same sort of thing for data files on disc.

The second case occurs when the program itself is too long. In this case the program needs to be segmented in an intelligent way. A similar situation arises when two or more programs are used to operate on the same set of data.

Larger computers, with newer microprocessors like the 6800 or 80186 and with 256K dynamic RAM chips like the 41256 can directly address much more than 64K. Smaller Z80 computers use bank-switching. This way the TS2068, for example, can address up to 16 Mbytes (although how is not clear -- its not in the manual!). Incidentally, the new SINCLAIR QL uses both a 68008 and a 8049 with 128K RAM 32K ROM, and two 100K microdrives (for $499).

This article is part 1 of some experimants in memory management for the ZX81/TS1000/TS1500. Both software and hardware will be discussed and any suggestions as we go along will be welcome.

In this install ment we will look at an overall scheme and then examine some of the software required. In part 2 hardware will be discussed.

These articles are intended primarily for the experimenter but should enable a TS1000 user to put together quite a sophisticated bank-switched system at a reasonable price.

The ZX81/TS1000 memory map is shown in Figure 1 for reference. The three main areas in-and-out of which we might like to transfer data are:

	LIMITS	
PROGRAM	16509	D-file
DISPLAY FILE	D-file	VARS
VARIABLES	VARS	E-line - 1

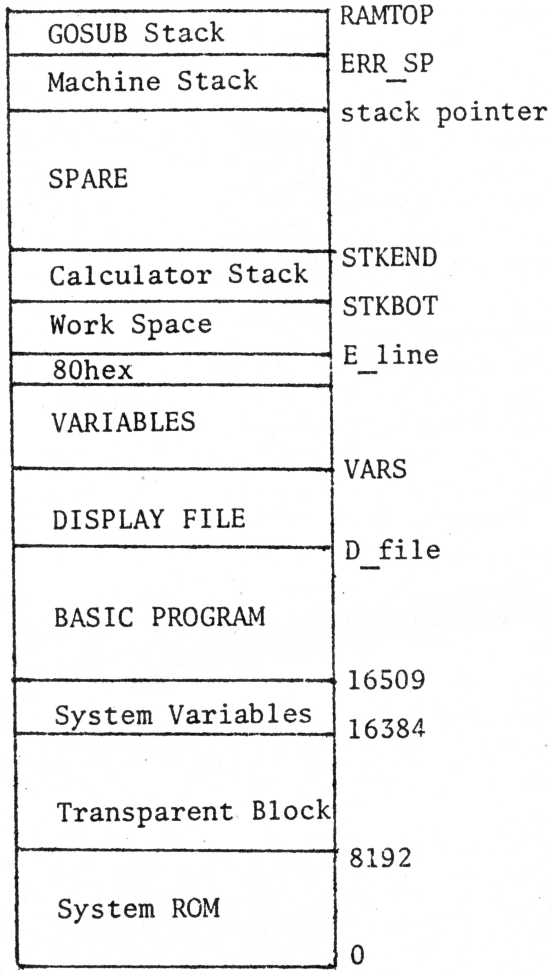


FIGURE 1

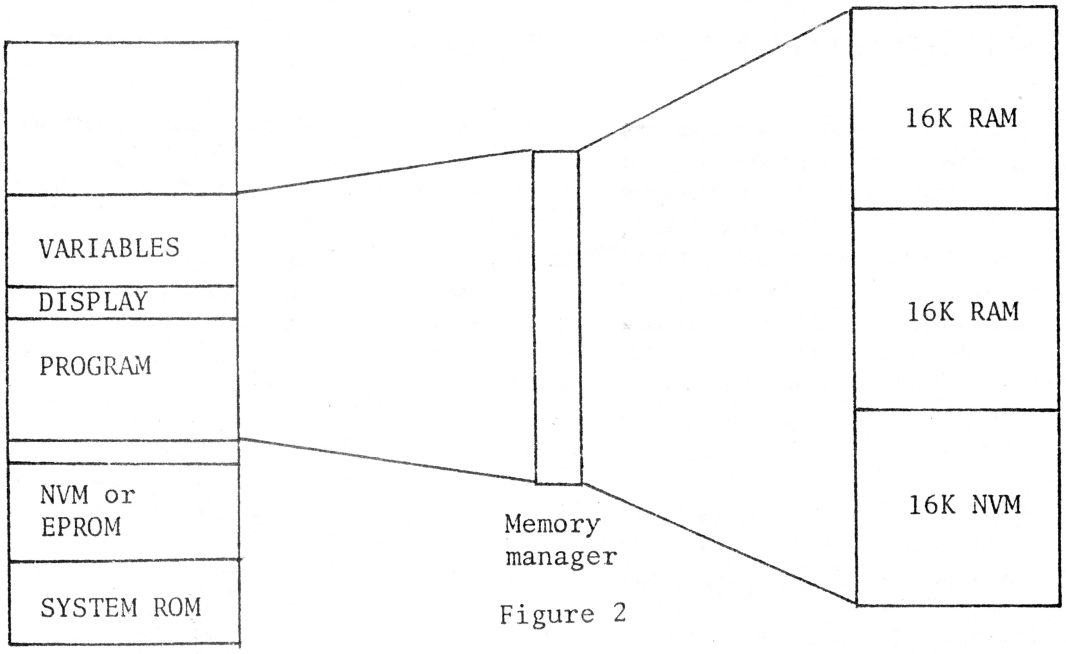


Figure 2

In the system to be described the primary memory will be addressed form 0K to 48K. The secondary memory will be addressed from 48K to 64K. This location is a logical choice because it cannot be used for BASIC programs directly.

The secondary memory will be 48K divided into three 16K blocks although the number of these blocks can be expanded later. Of these three blocks two will be ordinary dynamic RAM but the third will be nonvolatile static CMOS RAM. It is this later block which is potentially the most useful although all of the secondary memory could be normal volatile RAM if desired.

Thus the total system will comprize 8K ROM, 8K EPROM or NV RAM for operating routines kand utilities, 32K BASIC ' primary memory, 16K nonvolatile secondary memory, and 32K secondary RAM -- a total of 96K. This system is illustrated in Figure 2.

Note that programs are only stored in the secondary memory. To be run they must first be transferred to the primary memory. The system routines required to accomplish these transfers are essentially:

RECLAIM	primary memory (clear designated block of memory)
LOAD	into primary memory (includes merge)
PURGE	secondary memory (remove unwanted data or programs)
SAVE	into secondary memory

Most of these operations apply to all three areas PROGRAM, DISPLAY, and VARIABLES.

There are some other routines such as search for and locate a file, list the directory, switch memory banks, and others which will be needed. First, let's look at some examples.

Suppose a portion of the primary RAM needs to be cleared to make room for another program or subroutine which is to be loaded from the secondary memory. What's the procedure? Fortunately there are several routines in the system ROM which make the task easy. The first we'll experiment with is called LINE-ADDR. It finds the starting location of any line in a BASIC program.

TRY THIS EXAMPLE:

```
10 REM 1 2 3 4 5 6 7 8 9 0 1 2
20 INPUT A
30 POKE 16519,INT (A/256)
40 POKE 16518,A-256*PEEK 16519
50 PRINT USR 16514
```

Load the machine language into the REM statement:

```
                        COMMENTS:
16514 205  35 15  Call FAST
16517  33   lo hi  lo&hi are POKED
                   in the BASIC
                   program
16520 205 216  9  Call LINE-ADDR
16523  68  77      Store HL in BC
16525 201         Return to BASIC
```

Now run the BASIC program. When prompted (line 20), enter a line number such as 10. The result 16509 will immediately appear. Try some other line numbers.

This routine allows us to specify lines in a BASIC program to be deleted or moved. Now let's look at another system routine called RECLAIM (there are two entry points 1 and 2). As its name suggest, this routine reclaims space in the memory.

TRY THIS EXAMPLE:

Enter any BASIC program such as:

```
10 REM 12345678901234567890
20 INPUT A
30 INPUT D
40 POKE A,D
50 PRINT A,D
60 LET A=A+1
70 GOTO 30
```

NOTE: REM must be 20 characters for this particular example. Any BASIC program could be used but this one happened to be convenient because it is used to enter the machine code.

Now enter the machine code into the REM statement.

```
16514 205  35 15  Call FAST
16517  17 151 64  Load DE with
                   addr. of line20
                   in BASIC prog.
16520  42  12 64  Load HL with
                   loc. of D-file
16523 205  95 10  Call RECLAIM-1
16526 201         Return to BASIC
```

Now enter as a direct command RAND USR 16514. The BASIC program from Line 20 to the end has been erased but the REM statement containing the machine code is still there. Try it with another BASIC program and try a different line number (use LINE-ADDR to find the location -- i.e. combine the two routines together).

A third system routine we will make a lot of use of is called MAKE-ROOM and is located at 2462 decimal. Its funcion is to generate BC spaces at location HL. The fourth routine is not in the system ROM so it has to be written. We'll call it simply MOVE and its function is to move a program, display file, or variables into or out of the primary memory area. It's convient to divide the routine into two for the two tasks -- we'll call one MOVIN (into primary) and the other MOVOUT (into secondary from primary).
We'll continue next month.

ERROR RECOVERY

by Bill Johnson

The phrase "Error Recovery" refers to features, within a computer program, that allow the user the ability to easily change specific data items that have been errantly keyed in without re-entering all of the data. It is a programming concept that is often ignored, especially when we've been raised on the squeeze-everything-into-2K mentality. But, assuming we learn efficient programming techniques from using limited RAM, we need to use the memory that we do have to make our programs accessible and usable. An Error Recovery (E.R.) is one of the most effective (after coherent input/display techniques) methods of achieving the goal of software usability. If an end user knows that what he has keyed-in can always be re-entered or altered, this gives them a greater degree of psychological and actual control over the software.

There are 2 primary components of efficient E.R.:

1. That it be accessible at the appropriate times. The user must be able to use it when he is most likely to need it. After program exection is not an appropriate place for E.R. It would serve a function, but not the intended one.

2. That it require few, if any, additional keystrokes either to access this feature, or bypass it. If it interrups or substantually slows the data entry process, it becomes counterproductive. Ideally, if it is desirable to notice the E.R., it would require a single keystroke to bypass, and if it is desirable to have the E.R. go unnoticed, it would require a single keystroke to access the feature.

The simplest form of E.R. (we'll look at a more difficult one later) would allow changes to each entry only immediatly after they were keyed-in. This would be helpful for errors made by too-quick hands that are recognized immediatly. In the following short example the two pieces of data can be entered normally, but if the 1st is entered incorrectly, hitting the return (enter) without entering the 2nd piece of data will move the program back to the initial entry. If this technique was used with a long series of data entrys, you could actually step back through all the data.

```
8000 LET X=1
8005 PRINT AT X+1,0;"
                    "
8010 PRINT AT X,0;"SPAN OF BEAM?
"
8015 INPUT S$
8020 PRINT AT X,25;S$;"    "
8030 LET X=2
8035 PRINT AT X,0;"UNIFORM LOAD?
"
8040 INPUT U$
8045 IF U$="" THEN GOTO 8000
8050 PRINT AT X,25;U$;"    "
9999 STOP
```

If the second entry is null (no data), line 8045 sends the program back a step to 8005 which blanks out the second data inquiry as it returns to the first.

This type of E.R., though, is limited in scope. It serves a useful purpose for a very specific type of error, but as the only E.R. it can be awkward. Its exclusive use would force the user to check his/her overall data after each entry, even if it is entered correctly. This much mental jumping around is annoying and defeats the purpose of the E.R. feature: to facilitate use of your software.

The most natural time to check data for inconsistencies is when the program data (or a subset of the data) has been imput into the computer and is displayed on the screen. At this point the mental tendency is to scan the information for errors. If all of that information is easily accessible, the control that has been gained is enormous. It allows the data entry process to be quick and efficient, with access to all of the information for review and correction.

Access to all screen information presupposes an organized input/display format, because if there is no structure to the way the data are stored/displayed, the programming becomes hopelessly inefficient. In the December '83 issue of TS Horizons I presented this idea of a structured display under the name Matrix/Cursor

Input. Now , at the risk of losing those of you who have not read that article, I'd like to dredge up the programming example that I used and expand it to include a comprehensive E.R. capability.

```
ROOM:LIVING

GLASS DATA     1      2      3      4

AREA(SQFT)     1024   572    544    750
DEG.HORIZ.     90     90     75     9
DEG.REF.<      10     55     10     -80
OVERHANG       24     24     0      24
WINDOW HT.     72     48     72     72
HEAD TO OH     8      8      0      8
NO.GLAZNGS     2      2      2      2

ERR?
```

The data in that example is input by columns, with a set of seven data items filling up the column before moving to the second column. When the last item is entered into the data set, the question "ERR?" is printed 2 lines below in order to prompt the user to review for errors. If there are none, hitting the "N" key only (no return) will continue the program. But the "Y" key will place a cursor adjacent (on the left) to the data item at the top of the column. You may then step down the rows of data with the "RETURN" key, entering data only where the mistake was made. The "ERR" will continue to appear after each data correction until you leave that mode with the "N" key.

The first half of the following listing (lines 4000-4195) is from my article MATRIX/CURSOR INPUT which carries a detailed explanation of that section. You can obtain a copy (Dec./83) by sending the cover price to TS Horizons. The E.R. is nested inside the second (outer) loop (lines 4200-4275), and comes into play at the bottom of each column of the seven-row, four-column matrix.

VARIABLES

I(4,7) - array that stores all glass data.
Y - print position variable that indicates column
X - print position variable that indicates row
NO - number of glass areas
N - loop variable, indicating which column is operating.
B$ - Alphanumeric variable to read-in single-key entrys.

```
4000 REM MATRIX/CURSOR
4050 DIM I(4,7)
4060 LET Y=8
4080 PRINT AT 0,0;"ROOM:LIVING"
4090 PRINT AT 2,0;"NO.OF GLASS A
REAS?"
4095 LET B$=INKEY$
4097 LET NO=CODE B$
4100 IF NO<29 OR NO>32 THEN GOTO
 4095
4105 PRINT AT 2,0;"GLASS DATA
"
4110 PRINT AT 4,0;"AREA(SQFT)"
4115 PRINT "DEG.HORIZ."
4120 PRINT "DEG.REF.<"
4125 PRINT "OVERHANG"
4130 PRINT "WINDOW HT."
4135 PRINT "HEAD TO OH"
4140 PRINT "NO.GLAZNGS"
4150 FOR N=1 TO NO
4155 LET Y=Y+5
4160 PRINT AT 2,Y;N
4165 FOR X=1 TO 7
4170 PRINT AT X+3,Y;"     "
4175 PRINT AT X+3,Y;"?"
4180 INPUT I(N,X)
4185 IF I(N,X)>=10000 THEN GOTO
4170
4190 PRINT AT X+3,Y;I(N,X)
4195 NEXT X
4200 PRINT AT X+4,Y-1;"ERR?"
4205 LET B$=INKEY$
4207 IF B$="" THEN GOTO 4205
4210 PRINT AT X+4,Y-1;"   "
4215 IF B$="N" THEN GOTO 4295
4220 LET X=0
4225 GOTO 4235
4230 PRINT AT X+3,Y-1;" "
4235 IF X=7 THEN GOTO 4270
4240 LET X=X+1
4245 PRINT AT X+3,Y-1;"?"
4250 INPUT B$
4255 IF CODE (B$)=0 THEN GOTO 42
30
4260 LET I(N,X)=VAL B$
4265 PRINT AT X+3,Y-1;" ";I(N,X)
;"  "
4270 LET X=8
4275 GOTO 4200
4300 NEXT N
```

REMARKS on the PROGRAM LISTING

4200: print ERR? message
4205: read in keystroke for single-key (Y or N) entry
4207: if B$ null, continue scan
4210: blank out ERR? message
4215: if "N" key is depressed, bypass error recovery
4220: start E.R.loop with X at 0
4225-4230: blank out cursor from line above, except first time through. It could interfere with headings on that line.
4235: bottom of E.R. loop
4240: increment X
4245: print cursor adjacent to data item to be changed

```
4250: input new data
4255: if no new data, blank out
      cursor and move to next
      data item
4260: place new data into array
4265: overwrite cursor and old
      data (and any trailing
      digits) with new data
4270: reset X to max. for ERR?
      message
4275: return to ERR? message
4300: bottom of loop
```

As an even more complex alternative, you could write an E.R. feature that accesses the whole matrix at the end. The important point to emember is that you're trying to make the software easy to access, so the E.R. has to be located where it is needed. Location, Location, Location as they say in real estate. This can get us beyoud just elegant programming, into software that's elegantly easy to use.

BOOK REVIEW

By Rick Duncan
Converting to Timex
Sinclair Basic
by Stuart Bird
Wayne Green Books
Peterborough, NH 03485

This book is a guide to "Translating" BASIC programs written for other microcomputers to Sinclair BASIC. The format of "Converting" is said to be "dictionary" style. Hundreds of BASIC commands are cataloged in various chapters, e.g. String Functions, Numeric Fuctions, Loops, Direct Memory Address, Graphics, Matrix Statements, etc... Each contains a dozen or so entries. Thus for each BASIC word in the program you wish to convert, the word is located in the index and the reader if refered to the page where the entry is found.

Each entry is formatted as follows:

1. A heading, which contains the BASIC word plus any synonyms.
2. A brief description of the use and operation of the word in its own version of BASIC.
3. The TS 1000 replacement, i.e., an expression, program line, or more often, a short subroutine, in a generalized form, which exactly or nearly duplicates the action of the non-Sinclair word.
4. Discussion of application. The discussion is generally quite thorough and considers various cases where the replacement may (or may not) work, where modifications are required and other factors. This section includes a specific example of the use of the replacement.

Reading through the bewildering array of functions and commands from the various BASIC dialects makes one appreciate the Sinclair system of a strictly limited number of keywords, easily found on the Sinclair keyboard. Its relatively small vocabulary is not necessarily a drawback, as Mr. Bird points out, given the power and versatility of Sinclair BASIC. In the STRING FUNCTION chapter, he states:

> "(The) Sinclair BASIC string slicer is easily the most powerful and convenient string manipulation scheme available...While the Timex/Sinclair 1000 string slicer gobbles up expression such as X*2+3+sinX-VAL Q$ like PAC-MAN... most BASICS only spit these string function arguments back with error codes...

While the book does cover a large number of common BASIC commands, it isnot exhaustive. For instance, some common commands, like HOME (from Applesoft, Commodore, and others) are not included.

My favorite replacement is for DEF-FN in which the function is entered into the program as a string and the VAL command extracts the function value, by a short subroutine.

The book's cover promotes "Converting" as the "answer to your software shortage," which puts "an almost endless supply of programs... at your fingertips". However, if you're expecting to use the book to churn out hundreds of programs by mechanical substitution of BASIC instructions into programs from back issues of COMPUTE! and BYTE, I think you'll be disappointed. There are some inherent difficulties in translating programs.

1. Extensive use of PEEK and POKE.

2. CALL and USR.
   Such programs require memory maps and thorough knowledge of both computers. In some cases, conversion may be impractical in terms of time and energy.

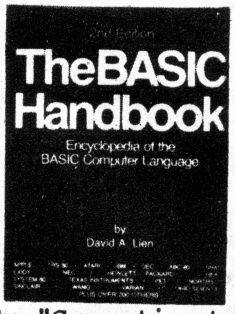
3. Graphics - The low resolution of the Timex display is an inherent limitation of program conversion in some cases. However, Mr. Bird does provide good replacements for cases where high resolution is not critical and also a program to perform Logo-like functions.

Even when these considerations are not problems, word-for-word translating generally does not produce efficient programs. Every computer and every BASIC dialect have their particular strengths and weaknesses. In every case, the original program needs to be broken down and carefully studied before the actual "translation" begins.

At that point, "Converting to Timex/Sinclair BASIC" becomes quite useful. The discussions of the commands helps the programmer to understand what the original programis intended to do.

All in all, "Converting to Timex/Sinclair BASIC" is a valuable reference book, and an extensive, though not exhaustive, guide to program conversion.

BOOK REVIEW



by Rick Duncan
"The BASIC Handbook
by David Lien
Compu soft Publishing
1050 E. Pioneer Way
El Cajon, CA 92020

As a companion volume to "Converting to Timex/Sinclair BASIC", "The BASIC Handbook" would be useful to many Timex/Sinclair users. It covers many BASIC dialects including Apple, TRS-80, Atari, IBM, DEC, TI, etc... and even Sinclair (ZX-80). However, the copyright date is 1981, thus Timex, Commodore (except PET), and other newer computers are not covered.

The format is similar to Converting, but the order is strictly alphabetic by BASIC word. The book has a feature Converting lacks, which is an introduction with some useful comments on program conversion. The back of the book contains short discussions of several specific computers, plus an index in which the reader can make notes on each BASIC command as he runs across it.

HARDWARE REVIEW
by P. Donnelly

ITEM: DK'TRONICS 16K UNCASED MEMORY BOARD
FROM: DK, SUFFERN, WALDEN, ENGLAND (799-22159)
PRICE: $31.95 +S&H (check exchange rate)

I no sooner got my big keyboard from DK'Tronics ready to use, than I plugged in the 16K uncased memory pack. The big advantage of this pack, is that it fits neatly inside the DK keyboard. The big disadvantage is that mine doesn't work right. (more later)

The board uses the same 4116-3 chips used in the Sinclair pack, but does its decoding through a

SOFTWARE REVIEW

by Gordon Young

ITEM: FASTLOAD

FROM: International Publishing and Software.

PRICE: $19.95

Getting programs into the computers memory is a problem we are all too familiar with. It is not a problem related to just the TS-1000, but most others load at the same rate. The new TS-2068 however, operates a bit faster so owners of the 1000 may want to speed this process up. The product "Q-Save" has been known to work for some, but I went through 5 units with the same problem and eventually withdrew from the effort. CAI has a very nice unit called a stringy floppy that uses small (matchbook size) cassette wafers and loads reliabley and quickly (as fast as some disk systems I have known).

Some other alternatives are the software versions such as the one I would like to share with you. Acopy of "FASTLOAD" was provided me and this may be one you would want to get. It took me 2 tries to get the volume set correctly, but after that it loaded fine eaverytime (1 monute 37 seconds). The documentation included requires an eyepiece for those with less than 20/20 vision and you have a dozen or so pages to deal with. For me, this was more than I cared to deal with since I honestly feel that user friendly software should require little more than loading.

In an hour or so, I figured the intructions out and loaded what is called a monitor porgram, a program that resides in the memorey for as long as the computer is on but is not a part of that currently beging used. You have to"NEW" the machine afterwards and load your regular program (and hope that it doesn't use the same part of memory that the monitor does). Now you must transfer the program back onto tape in the "FASTLOAD" form. This is taken care of very fast and the monitors screen really goes crazy, indicating that everything is working just fine.

But just how fast is "FASTLOAD"? One tape I used normally takes four minutes 18 seconds and with "FASTLOAD" it loaded in 55 seconds. Not bad. Keep in mind, the convert all your tapes to the "FAST LOAD" format (and I have 48), will take quite a time. Another thing one should mention here is that some tapes will use that upper part of memory and can not be "FASTLOADED". If you have "THE ORGANIZER", "VU-VALC" or "FLIGHT SIMULATOR", forget it.

Overall, "FASTLOAD" does pretty much what it claims to do and some small changes can be made to reduce those 64K loading times. 64K is a lot of memory for even the modest user and who really enoys spending 15 minutes for it to get transferrrd from tape to RAM? "FASTLOAD" rates an 8 on my ten scale.

7400 and two 74LS157's. The special (+12,-5v) voltage levels are apparently simulated by using a 741 op-amp and a simple doubler. Since the board is meant to be used inside the DK keyboard it has no "pass through" edge connector as on the various Memotech units. The board could be used on the back of a standard TS/1000, but would have to be the last peripheral connected. Board construction appears professional and "wobble"'s less than Sinclair:16K pack.

That big "disadvantage" is that I can't get the pack to work with machine language tapes. I called DK'Tronics technical line for advise , but was told that this is the first (or second) of 20,000 units which had this problem. Theoretically, at least, the fact that the unit works in BASIC means it should work just as well in Machine Code. DK suggests I return the unit, along with a sample of a tape that doesn't run, and they will fix or replace it. I will do this, but don't look forward to the expense. One last complaint is about the lack of a schematic and rather sparse documentation. Before sending the package back to England I'll probably have to trace out the circuits and produce my own schematic in hopes of diagnosing the problem.

For now, I can't recommend this unit, even though it has a very attractive price.

BOOK REVIEW
by Tex Faucette

At the time of this writing, the reviewer has been the proud owner of a Timex Sinclair 2068 for a period of about two weeks. Quite a bit of travel and visiting with relatives has left little time for studying the T/S User Manual, but has clearly demonstrated that the 2068 does not show its full potential on just any old color TV. On a well adjusted receiver the graphics can be great, and on a good color monitor they might well be superb. Quality of color is often a matter of taste, and for my taste some of the colors leave somenting to be desired. I am expecially unhappy with the yellow, which I see as more of an orange hue. I purchased my 2068 at a discount store for $155.00, tax included.

Like all owners of machines new on the market, I began to wonder just what I was going to run on it. I found one answer in a CROWN Book Store, and at a very reasonable price. On with the review!

TATALIZING GAMES FOR THE TIMEX/SINCLAIR2000 SERIES by Hal Renko/Sam Edwards is published by Addison-Wesley Publishing Co. and sold by Crown Books for $5.95 plus tax. The book is printed on soft paper, a plus in my judgement as it may be read anywhere with no annoying glare from the paper.

The book contains some 30 games, ranging from a fairly primitive 27 line "Ship's Attack" to an adventure game containing almost 400 numbered program lines. Since the 2068 allows several statements per line, this must be quite an adventure! Between these two expremes are a wide variety of games that display very vell the diversity of programming techniques adaptable to the 2068. Data statements, for example, are entered using the "BIN" (binary) function to draw user-defined graphics directly off of an 8X8 design grid. But beware! Bugs are there!

My favorite game so far is called "Kentucky Derby". Three realistic horses, created with programmed pixels, vie for the honor of the winners circle. Odds are posted before each race, and one may place wagers from and initial bankroll of $100. Ones remaining assets are posted following the race, and placing a wager that exceeds your assets yields a warning that you are

KIDS PAGE

TIMEX COMPUTING FOR KIDS

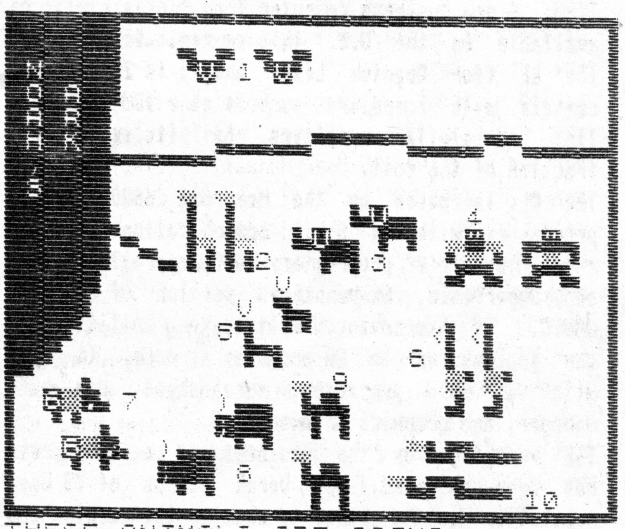
by Billy Lynn

ITEM: MINED-OUT

FROM: QuickSilva, 426 W. Nokoma, San Antonio, TX 78216

"MINED-OUT" is a game of strategy, skill, and logic. The object is to rescue Bill and Nora Mudroe(worms), and while doing that try to rescue Damsels. In order to do that you must avoid hitting any invisible mines that lie before you. On each board there are 2 safe areas in which there are no mines. Starting at the second screen, you can rescue Damsels. After you complete each screen or get eaten or blown up, it has an action replay. You can speed it up by pushing "S" for speed or stop it by pushing "E" for end. The high score is displayed by the player's initials. It's a fun game I like it really well and I think you will too.

Starting on the third screen addtional mines are droped but are visible. It's really easier then in my opinion. Bugs and Worms also chase you. So beware you have one life. To give you a goal I got 1260 points in one game. Bonus points may be accumulated.



THESE ANIMALS ARE GOING TO THE ARK, CAN YOU MATCH THE ANIMALS WITH THEIR NAMES?

1	ELEPHANTS
2	SNAKES
3	BUFFALOES
4	PIGS
5	OSTRICHES
6	APES
7	EAGLES
8	GIRAFFES
9	DEER
10	CAMELS

(NOTE: THIS PICTURE WAS MADE USING THE GRAPHICS OF THE TS-1000)

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living beyond your means. Unfortunately, the program contains and incorrect symbol which, until located and corrected, will result in an "integer out of range" error. (Clue: the error is NOT in the line given in the error statement.)I burned a lot of midnight oil on that one!

"Las Vegas a Go Go" is a colorful slot machine. It too contains a similar error which I WILL find, someday.

"New York, New York" places you in a helicopter, in control of numerous traffic signals below. As cars approach the signals (which are identified by keyboard symbols) you must key the proper symbols to keep the traffic moving. Once de-bugged this will be a good way to become familiar with the 2068 keyboard. You are working against time, and a score is displayed.

On all of the programs mentioned, use of the "PRINT FREE" command indicates that sufficient memory remains to "Polish" the programs. As an example, I intend to add the traditional trumpet fanfare to start my Kentucky Derby in place of the existing two "beeps", and program in a more exciting tempo and tone to the existing hoof beats!

TS NEWS

ITEM: A new business computer from Sinclair will be available in the U.S. this summer. It is called the QL (for Quantum Leap) and it is intended to compete with computers such as athe IBM-PC, Apple IIe, and similar computers, but its sells for a fraction of the cost.
The QL is based on the Motorola 68008 32-bit processor, with an 8-bit communications bus. It runs Sinclair's proprietary QDOS operating system and Superbasic, an enhanced version of Sinclair BASIC. It has advanced multitasking abilities and can process up to 20 programs at once. It comes with a word processor, spreadsheet, data-base manager, and graphics software.
The reception by the business and computer press has been reserved, but Derek Stubbs of TS User newsletter got a chance to examine the machine and he says it's better than Apple's Macintosh.

ITEM: We just got the TS 1000 version of the "1983 Tax Return Helper" from K-Soft. We didn't have time for a full review, but we did try it. It works really well (a little slow, though), and it can take a lot of work out doing your taxes. $14 ($18 for the TS 2068 version) from K-Soft, 845 Wellner Rd., Naperville, IL 60540. Add $1.50 shipping.

ITEM: Timex Sinclair User recently was taken over by a new company who has promised to restart the magazine with the April issue which will be available in late March.

ITEM: Karl Klotz of Christian Software contacted us recently about forming an association of Christian programmers. Some possibilities for the group are church and missions support, data banks, development of Christian software, religious instruction, etc. The association may or may not be specifically for Timex-Sinclair users. We at T-S Horizons would eagerly support such a group. It is only in the "idea" stage at this point. If interested contact T-S Horizons or Karl Klotz, Box 547, Rte. 590N, Bettsville, OH 44815.

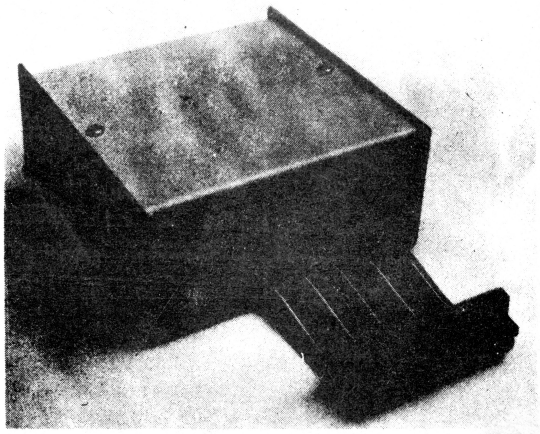
ITEM: PRO/FILE Updates is a quarterly newsletter that further enhances ZX PRO/FILE, the file manager (which Tex Faucette rated highly in his review last month). In it you can find instructions to modify the program for use with different printer interfaces, how to connect it to the AERCO disk system, how to make it run with ZXLR-8 or Q-Save. "Updates" shows you how to add new search and file management capabilities all designed to make ZX PRO/FILE the most powerful and uniquely personal file manager you can get for your computer. Subscriptions to ZX PRO/FILE are $9.95/year from Thomas B. Woods, P.O. Box 64, Jefferson, NH 03583. (603) 586-7734.

ITEM: We've heard a rumor that Mr. Woods is developing a version of PRO/FILE for the TS 2068 and Spectrum.

ITEM: ZX PRO/FILE is now available in EPROM form from Rompak, Suite 100, 8206 Blackburn Ave., Los Angeles CA 90048.

THE EXPANSION PACKAGE

by Minny Electronics



Introducing the ZX-GR. The "R" in ZX-GR stands for 64K Ram (56K usable), fully useful for all your programs — fully compatible with all your peripherals. Also, one of the few memories that is compatible with the TS-1500.

The "G" stands for Graphics Unit, the Hi Res. kind (255 x 192). The Graphics Unit is unique in that it does not tie up the memory map, once again compatability is preserved and more memory map is left for other peripherals.

Graphics units are only as good as the software that operates them, as some of you know. Our software package is fast, the draw circle command takes one second or less, draw line or rectangle even quicker. Do you like games? We have Sprites 32 x 32 Pixel Frames, 5 graphics pages, plus the ability to do foreground-background screens. In addition it can merge pages. If you're not into games it is also great for engineering modeling. Ease of use is its trump suit.

What is more you can save your graphics to cassette and load them back at a later time and the 2040 will hard copy any of the 5 screens.

You have your choice of two modes of operation: Etch-a-sketch or Manual Mode and Program Mode with 18 basic commands. Manual Mode can be used to draw screens and sprites manually with 8 axis control from the keyboard. Once again very responsive, in fact our extended software package has a magnify mode, in which the cursor is slowed down for more meticulous drawing. Program mode provides for the use of the following software commands from within basic statements: Plot, Unplot, Draw Line, Draw Rectangle, Draw Circle, Draw ULine, Draw HLine, Select Pages, Text, Store Sprites, Call Sprites, Start, Clear, and Fill.

By now you're probably asking, how much for all this capability? Well, let us look at the competition. Today, a 64K Ram can go for as much as $150 and the Graphics Unit goes for about $80; that's $230 for a unit without any software and can interfere with other peripherals.

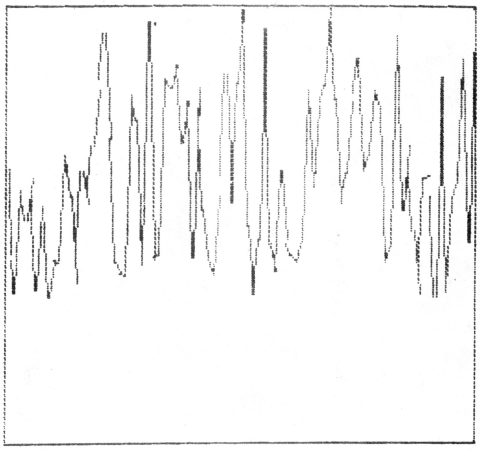
Our unit sells for $149.95 + $5.95 for shipping, handling and insurance. Minnesota residents: Add 6 percent sales tax. Send check or money order to: Minny Electronic Inc. 7332 Douglas Dr., Brooklyn Park, MN 55443. Tel. 612-566-2112.

Other products available:

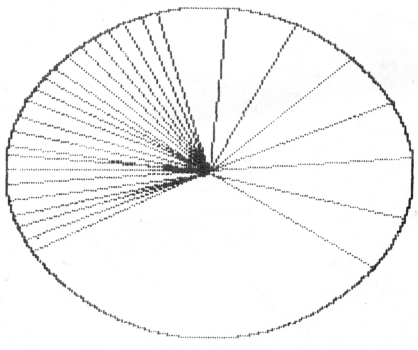
Extended Graphics Package	$29.95
ZX-GR Kit Minus Ram Chips	*Call*
Manual for ZX-GR	$2.00
Cross Assembler/6502 MP	$29.95

*A Cross Assembler assembles machine code for a different microprocessor (the 6502 used in the KIM, VIC, SIM, COM. 64, APPLE, II, II+, IIE, and the PET) than the host processor (Z-80A) TS-1000, -1500.

Note: This product is also sold by E. Arthur Brown Co. as the "MMRY-RES."



GRAPH'S



PIE CHARTS